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Static orthoses for the management of microstomia

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Abstract—Microstomia is a complication of facial burns, traumatic injuries, scleroderma, or surgical reconstructions involving the oral aperture. A variety of orthoses for the correction or prevention of microstomia are offered by dentists, occupational therapists, physical therapists, and other specialists. This paper provides an overview of the structural and clinical features of 12 common tissue-borne or tooth-borne microstomia appliances. The review is intended to facilitate the selection of suitable orthoses, and to indicate the need for interdisciplinary management of microstomia patients.
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INTRODUCTION

Microstomia is defined as a marked reduction in the size of the oral aperture. The condition occurs as a complication of facial burns, traumatic injuries to the face, loss of tissue elasticity as in diffuse facial scleroderma, and surgical reconstruction when the procedure involves the orbicularis oris muscle. Although numerous descriptive and research articles have been devoted to microstomia; its incidence has not been well documented. Authors have reported that 3.7 to 10.8 percent of all their thermal burn admissions and 31 percent of diffuse facial scleroderma cases are complicated by microstomia (6,16,18,25). This complication may result in abnormalities of oral symmetry, speech and dentition; disfigurement; psychological problems; functional inability in feeding; limitations in access for the provision of dental care; increased incidence of dental decay; and intubation hazards should general anesthesia be required (3,5,10,11,13,14,17,18,23).

The functional and cosmetic problems of microstomia are commonly treated by orthotic appliances that maintain the symmetrical position of oral commissures and stabilize the orbicularis oris muscle by means of two-point fixation. Specialists representing a variety of disciplines are involved in the fabrication or application of appliances, such as occupational therapy, physical therapy, physiatry, pedodontics, prosthodontics, plastic surgery, rhinolaryngology, and occasionally clinical engineering. Numerous authors have described selected microstomia appliances, but, to our knowledge, an overview of the variety that are in use by different professionals has not been published. The two parts of this article offer cross-disciplinary information about the clinical and structural features of major microstomia appliances.

Microstomia appliances may be static or dynamic in function and are constructed to be placed intraorally or extraorally. Static prostheses are those that have no movable parts once in place. Therefore, the pressure exerted by the device can be adjusted only through serial splinting or basic structural alterations. From the standpoint of clinical requirements, an important consideration in the selection of an appliance is whether it is tissue-borne or tooth-borne. The tissue-borne devices are useful for, but

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not limited to, edentulous adult patients or children with insufficient erupted dentition. The tooth-borne orthoses may be removable or fixed, with fixation advantageous when compliance is a problem. Tooth-borne orthoses also provide a more acceptable appearance.

The summaries below provide information on static tissue-borne and tooth-borne microstomia orthoses. The article following this one focuses on dynamic devices.

TISSUE-BORNE APPLIANCES

The Microstomia Prevention Appliance® (MPA) is an adjustable splint consisting of acrylic commissural posts, with two curved stainless steel bars between the posts (10). **(Figure 1)** The retention of the appliance is achieved through the application of horizontal pressure to the commissures of the mouth. A setscrew allows the appliance to be adjusted in 2-mm intervals. The splint is commercially available in three sizes (15): the small size adjusts between 38 mm and 50 mm, the large size between 45 mm and 63 mm, and the extra large size between 60 mm and 95 mm.

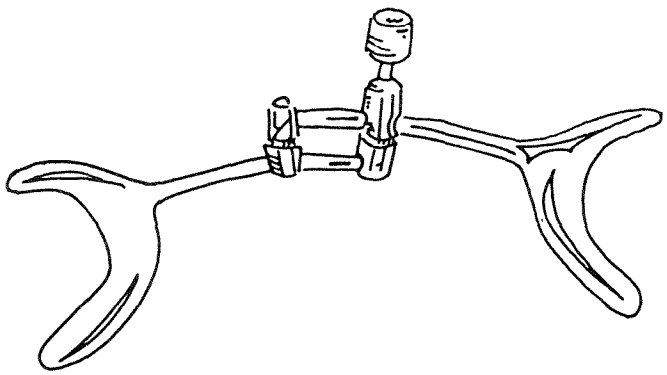

Figure 1.
Microstomia Prevention Appliance® with a set screw for 2 mm interval adjustments.

The major advantages of this device are its availability and ease of adjustment. It causes less drooling, speech impairment, or fixation of the lips than other microstomia splints (1). It is reusable, and may be returned to the manufacturer for sterilization and replacement of plastic parts.

There are several disadvantages to the use of MPA. The degree of adjustment of the splint may be too coarse, the small contact areas at the commissures may give rise to pressure sores, and the metal bar spanning the oral opening interferes with eating and drinking (1,7,14). The appliance is not suitable for young children as it can become dislodged and cause choking. This splint provides only a horizontal expansion of the mouth, which may not optimize functional oral opening, especially if the lips have sustained circumferential burns (14).

McGowan (14) adapted the MPA by fabricating two acrylic hooks fitting the angles of the mouth. These are connected by sliding bars which are locked by means of orthodontic screws. **(Figure 2)** This design provides an expansion stretch over a broader area than the MPA, and offers a fine degree of splint adjustment.

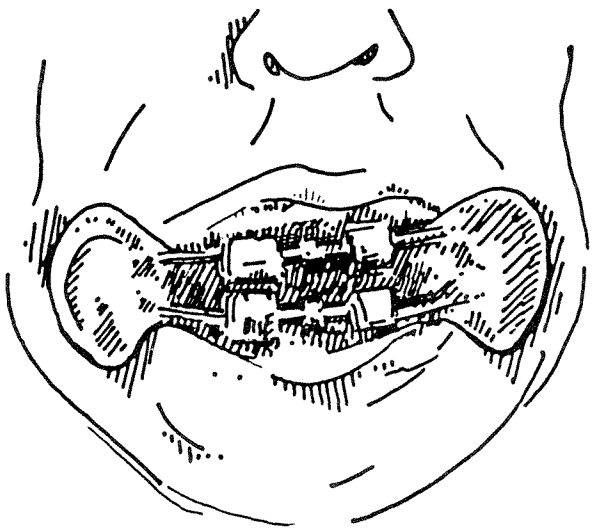

Figure 2.
McGowan's appliance with sliding bars and acrylic hooks with a range of movement of 5 to 6.5 cm.

Silverglade and Ruberg (23) modified the MPA by using two acrylic phalanges connected by a Hyrax (an orthodontic device used to split the palatal suture nonsurgically) to create a comfortable, imperceptible gradual expansion (0.25 mm) with each adjustment **(Figure 3)**. However, the expansile appliance and McGowan's sliding bars, like the MPA, interfere with eating and drinking, expand the tissues only in the horizontal direction, and are not suitable for young children as they may become dislodged and cause choking.

In order to overcome the lack of functional opening that can result from the use of splints that

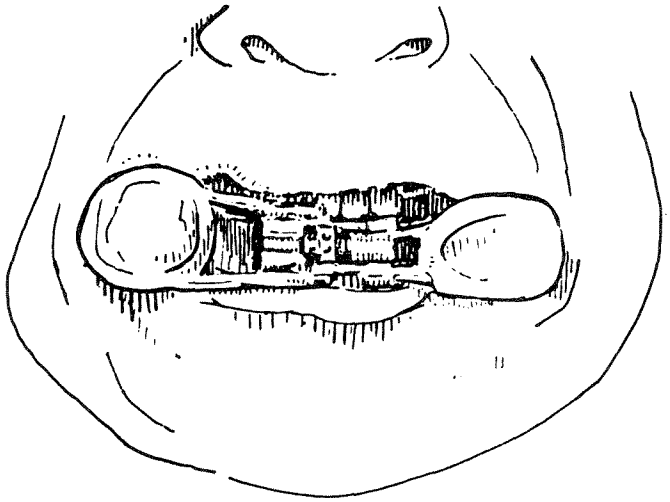

Figure 3.
Expansile appliance with acrylic phalanges allowing 0.25 mm interval adjustments.

increase only the horizontal dimensions, McGowan (14) designed a splint that stretches the lips vertically. **(Figure 4)** The acrylic resin portions of the appliance are shaped to fit against the upper and lower lips, and the sliding metal bars between the acrylic portions allow adjustment in the vertical direction. This application of vertical pressure to the lips appears to be a very effective means of increasing functional oral opening. However, patients experience some discomfort and difficulty in wearing the appliance for long periods. Due to mouth breathing, they experience drying of the gingiva and throat which may cause sore throats and cracked lips. There is difficulty in replacing the splint if it is not worn for a period of time (e.g., overnight).

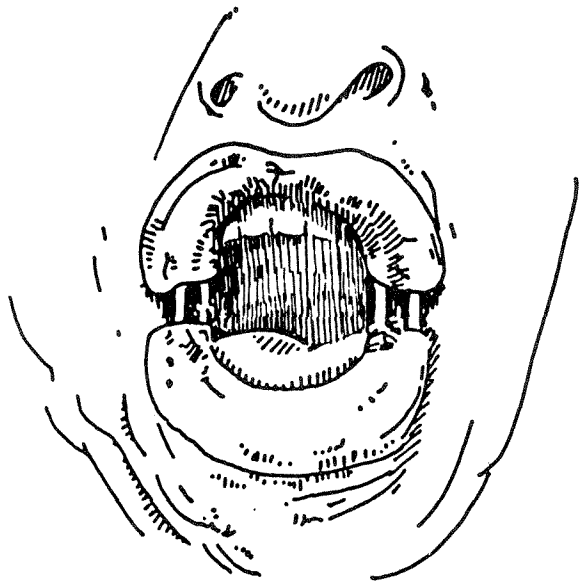

Figure 4.
Vertical stretch appliance with sliding bars and acrylic hooks applying pressure in vertical direction.

Clark and McDade (1) have produced an acrylic resin appliance consisting of two lip and cheek retractors mounted on vertical posts. **(Figure 5)** These retractors apply vertical and horizontal pressure to the lips, and outward pressure to the cheeks. Outward cheek pressure is thought to be important in enlarging the oral cavity of the edentulous patient. The metal bars and universal joints allow adjustability during application and removal of the splint, and for accommodation to changes in the size of the oral aperture.

Unfortunately, prolonged use of the appliance is uncomfortable, and promotes mouth breathing which has a drying effect on the gingiva. It is also bulky, requiring a certain degree of manual dexterity for its insertion. Patients often cannot insert the splint without assistance. Another disadvantage of this appliance is the time required for fabrication (4-6 hours).

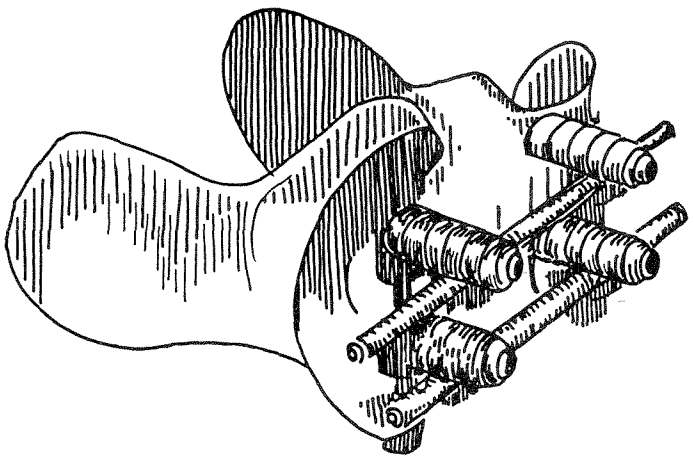

Figure 5.
Buccal Paddles appliance stretches oral aperture as well as the cheeks.

Flexible or semi-flexible orthoses, similar to mouthguards, have been described in the management of microstomia for the edentulous scleroderma patient, and for chemical burns of the oral cavity (16,21). **(Figure 6)** The construction is similar to that of conventional custom mouth protectors but the borders are extended into the depth of the mouth vestibule. These orthoses may be tissue-borne or

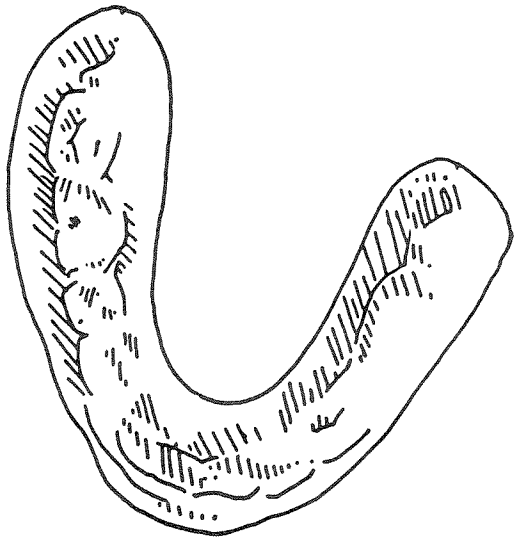

Figure 6.
Mouthguard appliance with a flat surface rim and thermoplastic joints to permit insertion of the prosthesis.

tooth-borne. They are reported to minimize two problems encountered with the above conditions: reduction in depth of the oral cavity and limitation of tongue movement (21). The appliance can be used in conjunction with mouth stretching and oral augmentation exercises (16).

Silverglade and Ruberg (23) have described a static tissue-borne orthosis consisting of an acrylic resin bar with connecting acrylic tusks. (**Figures 7a and 7b**) The tusks are positioned intraorally, and are retained passively by the cheeks. It is not easily adjustable and should not be used with young children as it may become dislodged and cause choking.

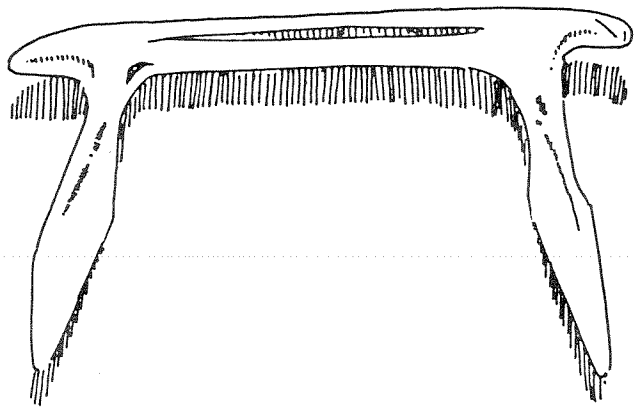

Figure 7a.
Acrylic Tusks appliance is fabricated from acrylic supportive tusks connected by a bar.

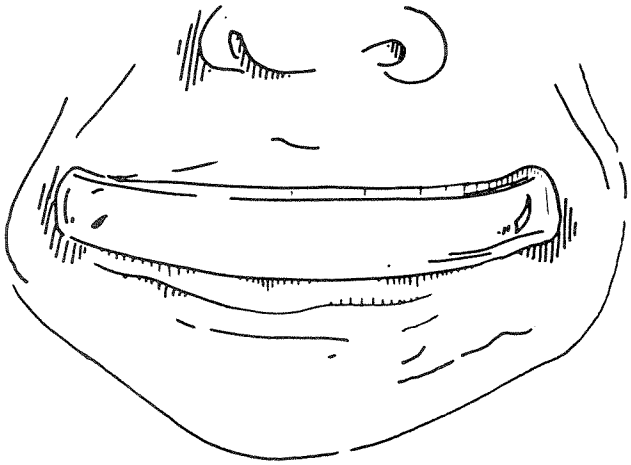

Figure 7b.
Acrylic Tusks in place, retained passively by the cheeks.

For children who have an incompletely erupted maxillary dentition and resultant difficulty retaining an intraoral appliance, an extraoral splint may be suitable. Richardson (18), and Holt et al. (11) have described the use of an extraoral acrylic facemask with commissural posts which is anchored in place with an orthodontic headgear cap (**Figure 8**). A general anesthetic is required to obtain the facial moulage necessary for the fabrication of this splint.

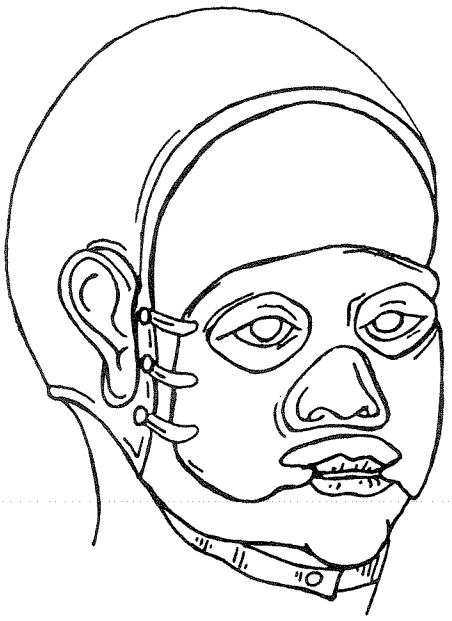

Figure 8.
Facemasks with two U-shaped posts to maintain commissures made of clear acrylic with holes for ventilation and pading over the forehead and malar areas for comfort.

A negative feature is the problem of the lack of patient or parent compliance that may be associated with wearing of the facemask.

TOOTH-BORNE APPLIANCES

Colcleugh and Ryan (2) in 1976, and Wright et al. (26) in 1977, were the first to propose an orthosis that is anchored to teeth to prevent contracture of the commissure. **(Figures 9a and 9b)** Modifications of their design have been described by several other authors and are thought to yield consistently good results when appropriately selected (2,3,4,9,11,12,13,20,26). The orthosis consists of a palatal shape which fits into the mouth (similar to an orthodontic retainer), and static acrylic posts which protrude extraorally at the commissures. Ideally, at least eight maxillary teeth are required for the anchorage of this device (3). Its construction is based on careful oral measurements and alginate impressions taken of the maxillary and mandibular arches (usually under anesthesia).

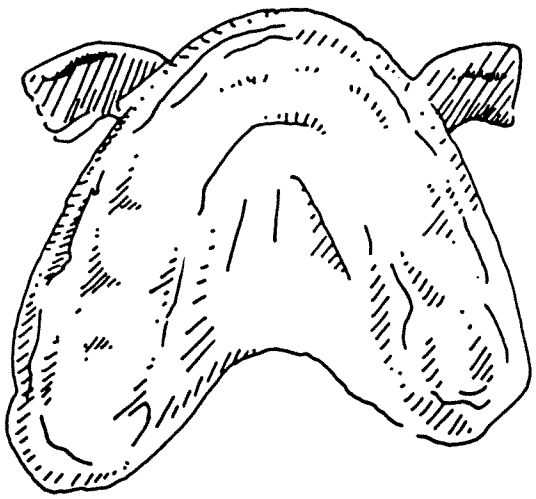

Figure 9a.
Acrylic Posts appliance with the palatal surface and commissural posts.

The orthosis is custom fitted and adjusted by a specialist in prosthodontics. For each periodic adjustment, more resin must be added to the posts. This orthosis can be designed as a removable (2,11,26) or fixed (9) appliance. The removable splint facilitates good oral hygiene, but may allow patient noncompliance with wearing the splint. The fixed splint can be sutured to the gums or cemented to the teeth,

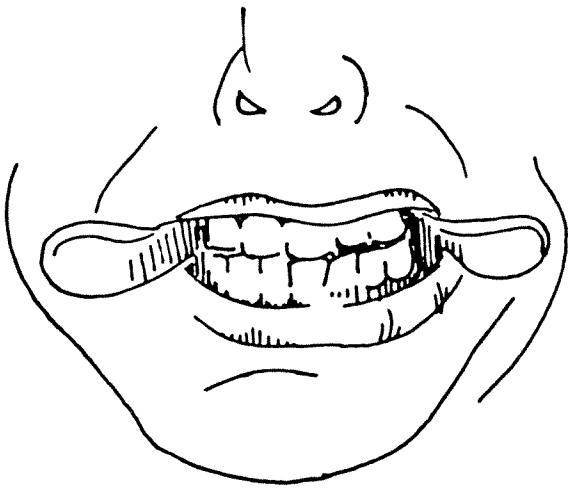

Figure 9b.
The appliance in place to maintain commissural dimension.

but presents problems with oral hygiene. Neither variation offers an adjustable stretch and therefore may not be suitable for circumoral burns.

A variation of the intraoral device described above is fixed maxillary orthosis with labial arch wire and acrylic commissural posts (11,22,23,24). **(Figure 10)**

Construction of the splint is based on an alginate impression of the maxillary arch. Buccal tubes are joined to orthodontic bands, or to chrome or stainless steel crowns, and to a labial arch wire to which acrylic resin prongs are attached (11,22,24). The prongs are 8 mm to 12 mm in diameter, 2 to 3 cm long, and they extend about 1 cm outside the mouth. They support the commissures symmetrically and oppose contraction forces of the healing tissues

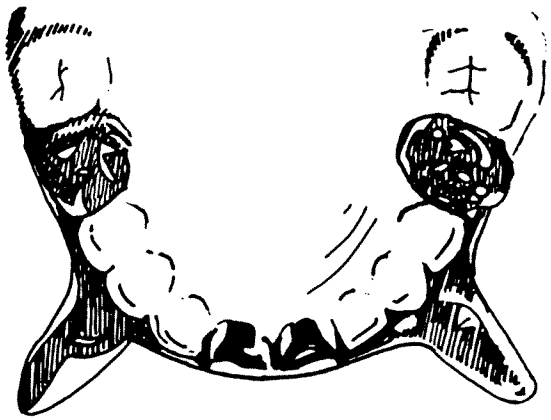

Figure 10.
Fixed Maxillary appliance with metal prongs imbedded in acrylic, and crowns fit to teeth for anchoring the appliance.

quite effectively. The cementing of the appliance to the teeth eliminates compliance problems.

Rivers (19), and Silverglade and Ruberg (23) have further modified the acrylic posts device. They have described a removable tooth-borne appliance similar to a mouthguard, with lateral projections or prongs at the commissures. (**Figure 11**) It is well retained by the teeth, but can be removed for eating and oral hygiene. Saliva continence is an advantage of this splint (19). The major limitation is that only horizontal pressure is applied.

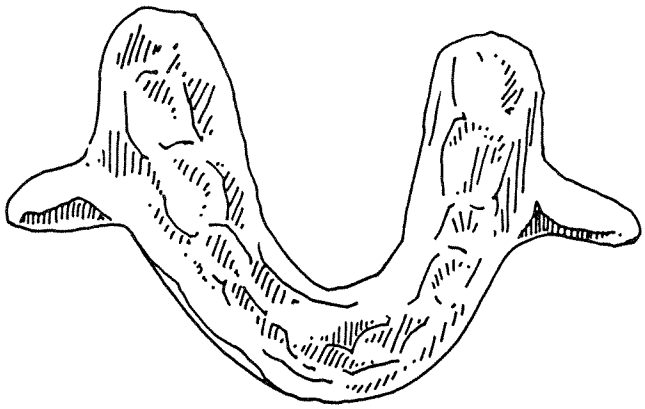

Figure 11.
Removable Maxillary appliance with supportive prongs to maintain commissural dimension.

Gorham (8) has described the fabrication of a simple thermoplastic device that takes less than 10 minutes to make, requires no special equipment, and is very inexpensive. The thermoplastic material is contoured to spread the angles of the mouth and lips and is held in place by bite plates molded to the upper and lower teeth. (**Figure 12**) The splint does not offer easy adjustability and is difficult to insert or remove. To be most effective, a new splint must be made each time the patient's oral opening increases or decreases a small amount.

DISCUSSION AND SUMMARY

Both static and dynamic appliances are used in the management of microstomia. This article offers a review of commonly used static orthoses to help maintain the size of the oral aperture and prevent microstomia.

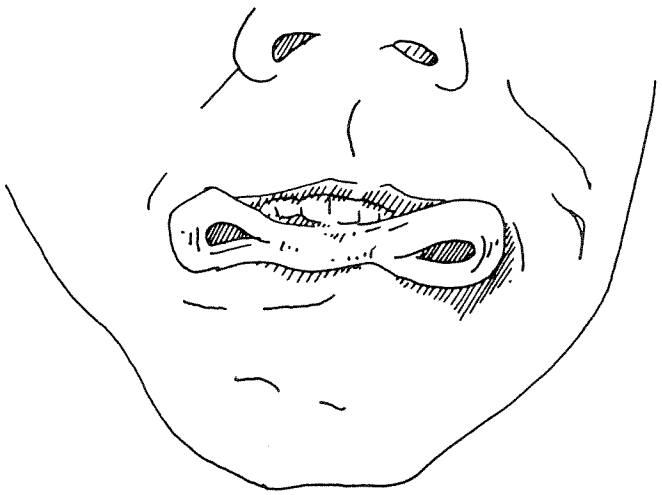

Figure 12.
Molded Bite Plate shaped to the upper and lower teeth and spreading the angles of the mouth.

The decision as to which microstomia splint to choose for a particular patient is dependent upon many factors—including presence or absence of teeth, the condition of the dentition, the patient's age, the patient's ability to comply with recommendations, the type and extent of injury, and expenses involved in delivering care (materials, fabrication, adjustment time, and durability). A summary of several important features of major tissue-borne and tooth-borne static microstomia is provided in **Table 1**.

All of the orthoses reviewed here can be modified to accommodate changes in the size of the oral aperture, but some are more easily adjusted than others. For example, splints with metal bars and setscrews, such as the MPA and those designed by McGowan (14) can be adjusted easily on a daily basis. However, the intraoral acrylic splints require time-consuming addition of acrylic to the commissural posts with each change.

Drooling, impairment of oral function, pressure sores, and patient compliance are common problems with the use of microstomia appliances (1,3,18,24). Some static appliances have definite advantages with respect to these concerns. For example, tooth-borne fixed orthoses are particularly effective in eliminating the compliance factor. A disadvantage of the intraoral splints is that an impression of the maxillary and sometimes mandibular arches must be made in order to fabricate the appliance. This is an additional

Table 1
Major structural and clinical features of static tissue-borne and tooth-borne microstomia orthoses

Type	Orthosis	Major Materials	Alginate Mold Required	Area Pressure Applied					Appropriate Age		
				Circum-Oral	Commis-sure	Oral Vestibule	Horizontal	Vertical	Adults	Older Child	Young Child (2 yr.)
TISSUE BORNE	Microstomia Prevention Appliance®	Acrlic, Metal bars	No		X		X		X	X	
	McGowan's Sliding Bars	Acrylic, Metal bars	No		X		X		X	X	
	Expansile	Acrylic, Hyrax	No		X		X		X	X	
	Vertical Stretch Appliance	Acrylic, Metal bars	No	X				X	X	X	
	Buccal Paddles	Lip retractors, metal bars, universal joints	No	X and Cheeks			X	X	X	X	
	Mouthguard	Acrylic and thermoplastic	Yes			X	—	—	X	X	
	Acrylic Tusks	Acrylic	No		X		X		X	X	
	Facemasks	Acrylic, orthodontic headgear	Yes		X		X				X
TOOTH BORNE	Acrylic Posts	Acrylic	Yes		X		X			X	X
	Fixed Maxillary	Acrylic, chrome crowns, wire	Yes		X		X				X
	Removable Maxillary	Acrylic	Yes		X		X		X	X	
	Molded Bite Plate	Thermoplastic	No		X		X		X	X	

laboratory operation. However, the improved quality of finish of appliances made by such a method may have significant benefit for the patient. In uncooperative or anxious children, the making of the impression must be done under a general anesthetic with attendant risks. Sedation techniques may also be applicable and are considered to be relatively safe.

It should be noted that if there is active scar tissue adjacent to the vermilion border, lip eversion cannot adequately be prevented by any of the orthoses described above. All of the orthoses have been reported to be effective in the management of microstomia when careful attention is given in appliance selection and monitoring.

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